— EXPERIMENTS —

— ON THE STRENGTH OF GLUE —
AND THE EFFECT OF MIXING OTHER
— INGREDIENTS WITH GLUE —

THESIS

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Walter F. Shattuck. School of Architecture.

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Shattuck

Glues

The subject of glues must necessarily be treated from more of a theoretical than a practical standpoint, which is necessitated by the fact that all good glues are practically twice as strong as all wood used for building purposes.

The liquid glues manufactured by the leading firms are good enough for all practical purposes, the cost being reasonable, and the saving of time considerable as the liquid glue is always ready for use, while the preparation of ordinary glue is always a laborious and uncertain affair to say the least. It usually being, cooked too much or not enough.

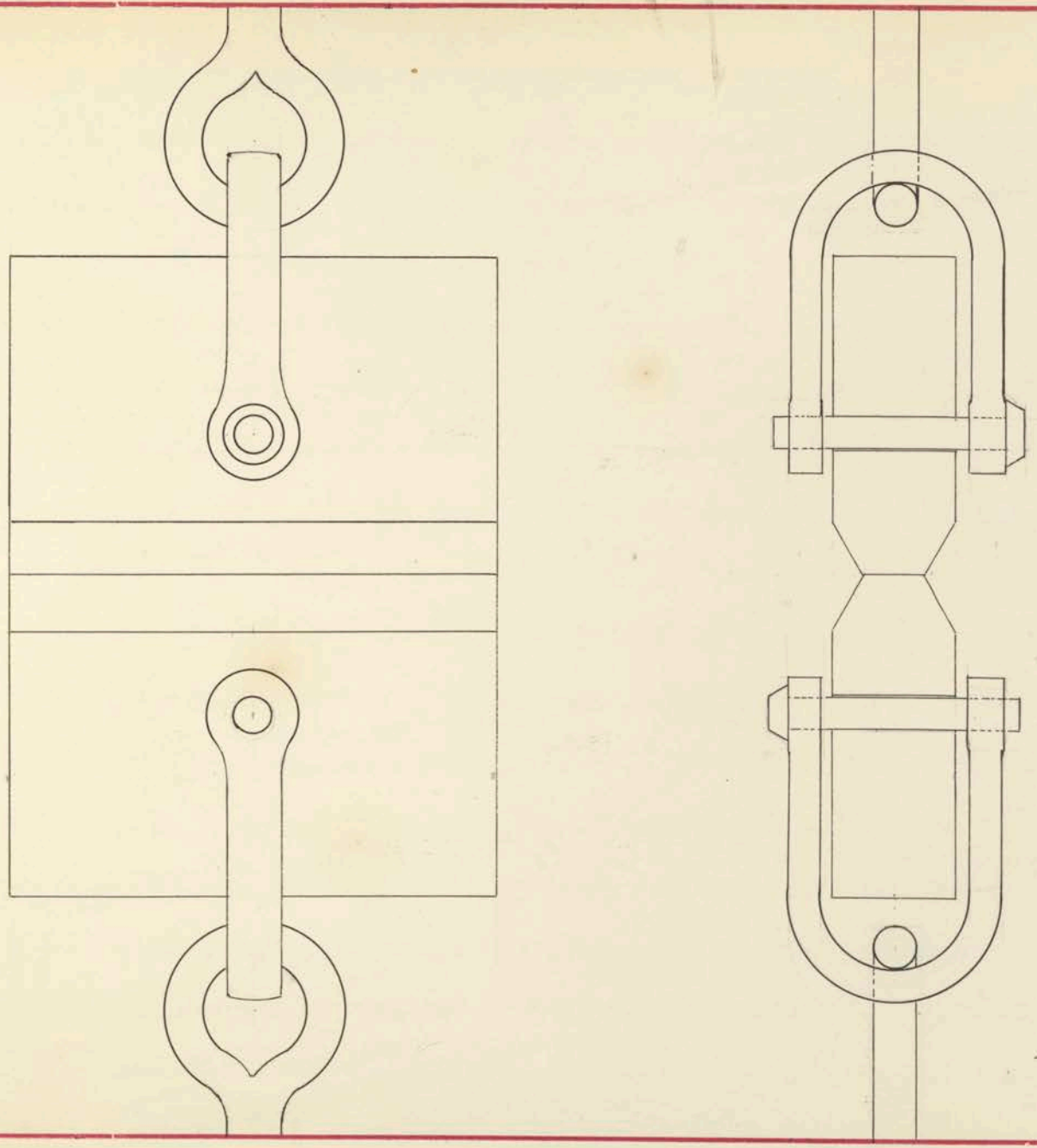
My first experiments were on the effect of acetic acid on glue.

I procured some commercial dry fish glue costing fifty cents per pound

My experiments simply extended to the dissolving of the glue in the different liquids

I diluted the acetic acid with water so as to produce different strengths, as follows. 1st. pure water 2nd 1/3 acid to 2/3 water 3rd 1/2 acid to 1/2 water 4th. pure acid.

The glue dissolved very quickly in the pure acid and remained soft not getting hard at all. The glue dissolved very slowly in the water and became extremely hard after a few days, it being impossible to cut it with a knife. The glue dissolved in 1/3 acid to 2/3 water, seemed to be in the best condition being perfectly clear and



and softenough to be easily cut.

I next procured some Le Page's liquid glue to experiment with in regard to miping lime chalk etc. with the glue.

I obtained some blocks of hard maple and shaped them as shown in sketch. The blocks being six inches long, four inches wide and one and one quarter thick. I beveled the edge to be jointed so as to be half the sectional area of the cross section of the block. The holes were centered 1 3/4" from the jointed edge. The joints were very carefully made in the proper manner.

My first tests were with blocks glued together with pure glue. The results are necessarily somewhat varying owing to the great difficulty of all the joints well made and properly glued. The tendency to buckle slightly when screwed up in

the clamps bring great.

I glued three pair of blocks together and after leaving them 24 hours I broke them. The first broke at 1670# by breaking thro the hole, area of cross section 7.146 sq. in., area of joint 4.278 sq. in.
1670# ÷ 4.278 = 390# per sq. in.

The second broke at the joint at 1640#
area of joint 4.3 sq. in. 1640# ÷ 4.3 = 381# per sq. in.

The third broke at the joint at 1120#, the joint being poor, Area of joint 4.48 sq. in.
1120# ÷ 4.48 = 250# per sq. in.

My next experiment was the mixing of lime with the glue. I mixed 4 grains of quick lime with 40 grains of glue. Mixed well and glued three pairs of blocks together with this mixture.

The first piece broke at the joint at 1750#

The joint being fairly good Area of joint 4.2 sq in
1750# ÷ 4.2 = 415# per sq in.
The second broke thro the hole at 1810#
Area of joint 4.62 sq. in.
1810# ÷ 4.62 = 3.92# per sq. in.
The third piece broke thro the hole at 1880#
Area of joint 4.42 sq in. Area of section 6.76 sq in.
1880 ÷ 4.42 = 425# per sq in.

In the next set I used 20 grains of glue and 1 grain of dry lime.
The first broke at 1740# thro the hole
Area of joint 3.67 sq. in.
1740# ÷ 3.67 = 474# per sq in.
The second broke at 1200# at the joint
Area of joint 3.3 sq. in.
1200# ÷ 3.3 = 364# per sq. in.
The third broke thro the hole at 1200#

Area of joint 3.67 sq. in.
1200# ÷ 3.67 = 327# per sq. in.
The result obtained in the first piece shows that the joint was somewhat defective in the second and third cases.

I next tried the effect of lime paste instead of dry lime. I mixed 20 grams of glue with 4 grams of lime paste. and glued 3 pairs together
The first broke at 1300# thro joint
Area of joint 3.3 sq in.
1300# ÷ 3.3 = 394# per sq. in.
The second broke at 1300# thro joint
Area of joint 3.67 sq in
1300# ÷ 3.67 = 354# per sq. in.
The third broke at 1400# thro joint
Area of joint 3.3 sq. in
1401# ÷ 3.3 = 425# per sq. in.

The results of these experiments with miping of lime and glue show that there is no practicae difference between using dry lime and using lime paste. By averaging the entire results it was found that the glue miped with from 5 to 10% of lime was 8% stronger than the pure glue

I next tried the effect of miping chalk with the glue. I miped 29 grams of glue with 2 grams of chalk.

First piece broke at 1160# thro joint
Area of joint 3.3 sq in.
1160 ÷ 3.3 = 351# per sq. in.
Second piece broke at 1080# thro joint.
Area of joint 3.3 sq in.
1080# ÷ 3.3 = 327# sq in
Third piece broke at 1200# thro joint.

Area of joint 3.3 sq. in.
1200# ÷ 3.3 = 367# per sq in.
I next took 19½ grams of glue and 3½ grams of chalk. The first piece broke at 740# thro joint.
Area of joint 3.3 sq. in.
740# ÷ 3.3 = 225# per sq. in.
Second piece broke at 1020# thro joint
Area of joint 3.3 sq in
1020 ÷ 3.3 = 325# per sq in
The third piece broke at 960# thro joint
Area of joint 3.3 sq. in.
960 ÷ 3.3 = 290# per sq in.
The results of these tests tend to show that chalk has little or no effect upon the strength of glue what little effect it does have tends to weaken rather than to strengthen the glue

The next tests were to see what was the effect of mixing water glass with the glue I. mixed 16.8 grams of glue and 3 grams of glass
The first piece broke at 1250# thro joint
Area of joint 3.3 sq in
1250 ÷ 3.3 = 480# per sq in.
The second piece broke at 1700# thro hole
Area of joint 3.4 sq in
1700 ÷ 3.4 = 500# per sq in.
The third piece broke at 1650# thro joint
Area of joint 3.6 sq in.
1650 ÷ 3.6 = 458# per sq in.
I next mixed 18.4 grams of glue and 1.8 grams of glass together
The first piece broke at 900# at joint
Area of joint 3.3 sq in.
900# ÷ 3.3 = 273# per sq in.

The second piece broke at 1600# thro hole
Area of joint 3.5 sq in.
1600 ÷ 3.5 = 457# per sq. in.
The third piece broke at 1230# thro joint
Area of joint = 3.4 sq. in.
1230 ÷ 3.4 = 368# per sq. in.
The results of these experiments show that the mixing of 15% glass with the glue, increases the strength about 25%, but as the price of the water glass is much greater than that of the lime it would be much more desirable to use the lime.

My last experiments were with regard to the amount of pressure that should be applied to a glue joint. For this purpose I glued the first two pair of blocks together and applied considerable pressure

One of the two joints was defective and broke easily. the other was good and broke at 1600# thro the hole

To the second two I applied a slight pressure Both broke at the joint one at 1400# and the other at 1340#

The last two I simply rubbed together and stood up. They both broke at the joint, one at 300# the joint being defective and the other at 1000#

These results would go to show that the greater the pressure on the joint the greater will be the strength of it.

Results of Experiments on Mixtures

1st. The addition of 16% Lime to glue increases the strength 20%

2nd The addition of 5% lime to glue increases the strength 15%

3rd The addition of 20% lime paste to glue increases the strength 15%

4th The addition of 7% chalk to glue increases the strength 2%

5th. The addition of 18% chalk to glue decreases the strength 18%

6th The addition of 18% water glass to glue increases the strength 50%

7th The addition of 10% water glass to glue increases the strength 8%

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